Remarks

I. Status of claims

Claims 12-20 are pending.

Claim 19 has been amended.

Claim 12 is an independent claim. Each of claims 13-20 depends from claim 12.

II. Claim rejections

The Examiner has rejected claims 12-20 under 35 U.S.C. § 103(a) over Thornton (U.S. 6,208,681) in view of Jiang (U.S. 5,719,893).

A. Independent claim 12

Independent claim 12 recites a method of manufacturing a VCSEL that comprises forming a vertical stack structure that defines two or more etched holes each extending from the substantially planar top surface to the oxidized peripheral region, and passivating each of the etched holes by an overlying moisture penetration barrier.

The Examiner has acknowledged that Thornton does not teach or suggest anything about passivating each of the etched holes by an overlying moisture penetration barrier. Nevertheless, the Examiner has asserted that Jiang makes up for this failure of Thornton's disclosure. In particular, the Examiner has asserted that:

> Since Thornton and Jiang et al. are both from the same field of endeavor, a method of manufacturing a vertical cavity surface emitting laser (VCSEL), the purpose disclosed by Jiang et al. would have been recognized in the pertinent art of Thornton. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Thornton by forming an overlying moisture penetration barrier as taught by Jiang et al. to chemically protect and passivate while allowing light to be emitted (col. 5, lines 53-56).

For the reasons explained below, however, one of ordinary skill in the art at the time the invention was made would not have been led to modify Thornton in accordance with Jiang's teachings. In addition, even assuming only for the purpose of argument, that such a

person would have been motivated to modify Thornton in accordance with Jiang's teachings, the resulting combination of Thornton and Jiang would not result in the inventive method recited in claim 12.

1. One of ordinary skill in the art would not have been motivated to modify Thornton in accordance with Jiang's teachings

One of ordinary skill in the art at the time the invention was made would not have been motivated to modify Thornton's structure to include Jiang's passivation layer 140 because Thornton's VCSEL already includes a silicon nitride passivation layer over the aperture region.

In particular, Jiang teaches that "By depositing passivation layer 140 over aperture 131, light emitting device 100 is mechanically and chemically protected or passivated while allowing light to be emitted" (col. 5, lines 53-56). According to Jiang, the passivation layer 140 is formed of a material, "such as oxide, nitride, oxynitride, or the like" (col. 5, line 43).

Thornton teaches that after the upper DBR mirror 114 is formed but before the cavities 126 are etched, "as is conventional, a uniform layer of silicon nitride will be deposited over the entire semiconductor sample" (col. 6, lines 3-5). That is, in accordance with Thornton's teachings, the aperture region of Thornton's VCSEL structure is passivated by a silicon nitride layer.

Since the aperture region of Thornton's VCSEL already includes an overlying silicon nitride layer, one of ordinary skill in the art at the time the invention was made would not have seen any need to additionally include Jiang's passivation layer 140 over the aperture region in Thornton's VCSEL. Indeed, one of ordinary skill in the art at the time the invention was made reasonably would have concluded that such a modification of Thornton's VCSEL would have been redundant and would not have served any useful purpose.

For at least this reason, the Examiner's rejection of independent claim 12 over Thornton in view of Jiang should be withdrawn.

2. The Examiner's proposed combination of Thornton and Jiang would not result in the inventive method recited in claim 12

Even assuming only for the purpose of argument that there was sufficient motivation for one of ordinary skill in the art at the time the invention was made to modify Thornton's VCSEL in accordance with Jiang's teachings, the resulting combination would not correspond to the inventive method recited in claim 12.

In particular, with respect to planar VCSEL structures of the type described in Thornton, Jiang teaches that his objective of protecting a VCSEL from physical and chemical damage is achieved by depositing the passivation layer 140 over the aperture region of the VCSEL. For example, in col. 5, lines 53-56, Jiang teaches that "By depositing passivation layer 140 over aperture 131, light emitting device 100 is mechanically and chemically protected or passivated while allowing light to be emitted." Also, in FIG. 2, Jiang only shows the passivation layer 140 over the aperture surface 136 and the top conductor 130 circumscribing the aperture surface 136. Jiang does not even hint that depositing the passivation layer 140 over other regions of the planar VCSEL 205 would serve any useful purpose.

Therefore, assuming only for the purpose of argument that one of ordinary skill in the art at the time the invention was made were to modify Thornton's VCSEL in accordance with Jiang's teachings, such a person would include the (redundant) passivation layer 140 only over the top electrode 132 and the aperture region circumscribed by the electrode 132. Indeed, Jiang does not teach or suggest anything about passivating etch holes of the type described in Thornton. Therefore, one of ordinary skill in the art at the time the invention was made would not have been motivated to extend the passivation layer 140 beyond the region (i.e., the aperture region 131) that Jiang teaches is sufficient to achieve his objective of mechanically and chemically protecting the light emitting device 100 (see col. 5, lines 53-56). Thus, in the resulting VCSEL structure, the passivation layer 140 would not overlie the etch holes 126 as asserted by the Examiner.

For this additional reason, the Examiner's rejection of independent claim 12 over Thornton in view of Jiang should be withdrawn.

3. Conclusion

The Examiner has failed to persuasively explain why one of ordinary skill in the art at the time the invention was made would have been led to modify Thornton's VCSEL in accordance with Jiang's teachings. The fact that "Thornton and Jiang et al. are both from the same field of endeavor" is insufficient. In addition, the Examiner has failed to explain how the VCSEL structure resulting from the impermissible modification of Thornton's VCSEL in accordance with Jiang's teachings would result in the inventive method recited in claim 12. Based on these failings, it appears that the Examiner improperly has engaged in hindsight reconstruction of the claimed invention, using applicants' disclosure as a blueprint for piecing together prior art to defeat patentability.

For these reasons, the Examiner's rejection of independent claim 12 under 35 U.S.C. § 103(a) over Thornton in view of Jiang should be withdrawn.

B. Claims 13-17

Each of claims 13-17 incorporates the features of independent claim 12 and therefore is patentable over Thornton and Jiang for at least the same reasons explained above.

C. Claims 18 and 19

Each of claims 18 and 19 incorporates the features of independent claim 12 and therefore is patentable over Thornton and Jiang for at least the same reasons explained above. Claims 18 and 19 also are patentable over Thornton and Jiang for the following additional reasons.

Claim 18 recites "disposing a top electrode over the substantially planar top surface of the vertical stack structure and circumscribing a light emission region substantially free of any overlying moisture penetration barrier material" (emphasis added).

The Examiner has asserted the feature recited in claim 18 is met by the VCSEL fabrication method disclosed in Thornton. In particular, the Examiner has asserted that:

> Referring to claims 18 and 19, Thornton discloses disposing a top electrode (130) over the substantially planar top surface of the vertical stack structure and circumscribing a light emission

region substantially free of any overlying moisture penetration barrier material (col. 7, lines 21-49).

This rejection is disingenuous because Jiang clearly teaches that the passivation layer 140 must be deposited over the aperture 131 in order to achieve his objective of mechanically and chemically protecting the VCSEL (see, e.g., col. 5, lines 40-56, which is cited repeated by the Examiner). Accordingly, in any possible combination of Thornton and Jiang, the passivation layer 140 necessarily would be located on the aperture region (i.e., the light emitting region). That is, the combination of Thornton and Jiang teaches away from the inventive feature recited in claim 18.

For at least this additional reason, the Examiner's rejection of claim 18 under 35 U.S.C. § 103(a) over Thornton in view of Jiang should be withdrawn.

Claim 19 incorporates the features of claim 18 and therefore is patentable over Thornton and Jiang for at least the same reasons.

D. Claim 20

Claim 20 incorporates the features of independent claim 12 and therefore is patentable over Thornton and Jiang for at least the same reasons explained above. Claim 20 also is patentable over Thornton and Jiang for the following additional reasons.

Claim 20 recites that the moisture penetration barrier includes a peripheral edge intersecting the top surface of the vertical stack structure at a moisture penetration interface, and that at the top surface of the vertical stack structure each of the etched holes is circumscribed by a respective peripheral edge having a substantial portion separated from the moisture penetration interface by a distance sufficient to prevent substantial lateral moisture intrusion into the etched holes.

The Examiner has asserted that Jiang discloses these features in FIG. 2 and in col. 5, lines 40-56. There are, however, no etch holes shown in FIG. 2, nor is there any description of the relationship between the peripheral edge of the passivation layer 140 and the peripheral edges of etched holes in col. 5, lines 40-56. Thus, contrary to the Examiner's unfounded assertion, Jiang does not provide any disclosure whatsoever relating to the separation distance between the peripheral edge of the passivation layer 140 and the peripheral edges of etched holes.

Since neither Thornton nor Jiang teaches or suggests anything about the feature recited in claim 20, no combination of Thornton and Jiang possibly could teach or suggest such a feature. For at least this additional reason, the Examiner's rejection of claim 20 under 35 U.S.C. § 103(a) over Thornton in view of Jiang should be withdrawn.

III. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 50-1078.

Respectfully submitted,

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